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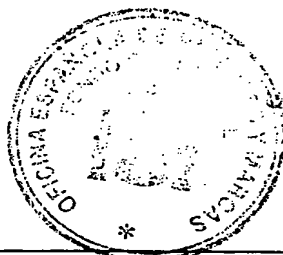


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(54) **DEVICE FOR STACKING SHEETS.**

(57) A device for piling up such sheets as conveyed after cut by a cutting machine on a stacking table. The sheets cut by the cutting machine are conveyed at fixed intervals, clamped during the running by a clamping unit at reference positions of the rear ends of the sheets, and the running speeds of the sheets are reduced to an optimum ones required for neatly

piling up the sheets. The clamping unit is provided with a rotating part having a free roller and a speed reduction roller at the tip thereof, in which, with each rotation of the rotating part, the free roller comes into contact with the speed reduction roller for clamping the sheets.

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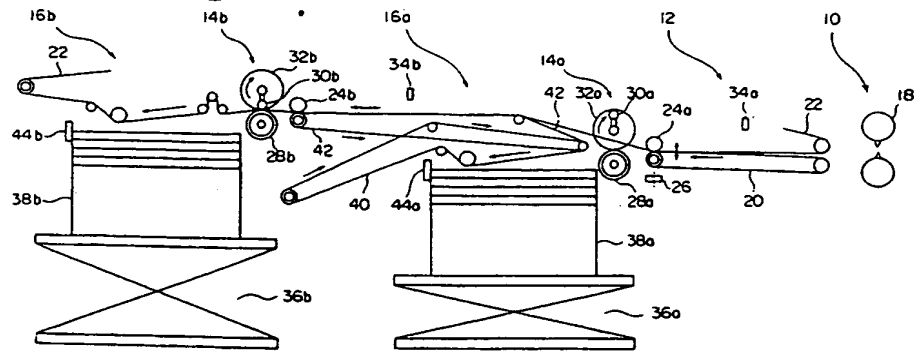


FIG. 1

## Technical Field

This invention relates to a sheet stacker to be used in the field of cutting corrugated cardboard, paper, plastic film, foil and the like, for slowing down sheet travelling speed to an optimum speed needed for stacking sheets cut by a sheet cutter orderly into stacking zone by clamping tails of sheets during transferring sheets, and for stacking the sheets directly and orderly into the stacking zone.

## Background Technologies

Conventionally as shown in Figs.7A and Fig.7B, in order to stack sheets of corrugated cardboard, paper, plastic film, foil and other various material cut by a sheet cutting machine 82 into the stacking zone, sheets 86 are transferred by a high speed conveyor 84 and their transfer speed is reduced by an overlap conveyor 88 (a low speed conveyor) having a speed difference from the high speed conveyor. The sheets, whose speed is reduced, are then overlapped on the overlap conveyor one after another, are transferred by the overlap conveyor, and are stacked into the stacking zone, lot by lot overlapped.

Many kinds of overlap conveyors are used. For example, sheets travelling on the high speed conveyor are nipped, slowed down and overlapped on the overlap conveyor by "pressing whiskers" of the overlap conveyor, with vacuum or the like, and are then transferred on the overlap conveyor. Or, sheets transferred by the high speed conveyor are slowed down and overlapped by "catching belt", "pressing belt", "low speed conveyor" or the like.

Fig.7A shows an example where pressing whiskers 90 are used, and Fig.7B shows an example where a catching belt 92 is used.

However, a system using such an overlap conveyor has various problems such that grazes are produced on surface of a sheet travelling at a high speed due to friction of "pressing whiskers", "catching belt", "pressing belt" or the like, the leading edge of sheet is folded or damaged because of high speed sheet transfer by the conveyor, and a sheet is normally because the leading edge of a sheet droops down or bumps against preceding sheet, especially when sheet stiffness is low.

Because cutting performance of cutting machine has recently been improved remarkably, it is required to transfer cut sheets at a high speed. Therefore, it becomes necessary to install another higher speed conveyor upstream of said high speed conveyor, resulting in lengthening a line by said higher speed conveyor, in necessity of a larger installation space, and in increase of installation

cost.

Furthermore, because materials to be cut by a sheet cutting machine are various including thicker and thinner corrugated cardboard, paper, plastic film, foil and the like, it becomes impossible to dissolve said various problems for such various materials by said conventional sheet stacker, namely by a stacker for transferring cut sheets by a high speed conveyor, reduction sheet speed by an overlap conveyor, overlapping the sheets, sending the sheets to the stacking zone and stacking the sheets into the stacking zone, lot by lot overlapped.

A means to dissolve such problems was disclosed in U.S. Patent No.557,439, "Tail Stopping and Knockdown Device". As shown in Fig.8, this device has a slowing down device comprising a brush roll 103 and a low speed roll 104 between a conveyor 101 and a stacking station 102. The rolls 103 and 104 are driven by a motor 106 through appropriate gears 105.

In this conventional technology, sheets are slowed down and sent to the stacking station 102, their portions near the tails ends being contacted by either one of two brushes 108 of the brush roll 103 and being pressed to the roll 104 rotating at a low speed, when sheets pass between two rolls 103 and 104. But with this type of brush roll 103, the action of brush 108 to press sheets to the roll 104 is unstable, and sheets could be damaged by the brushes in case of paper sheets or the like. Furthermore, the pressing positions of sheets cannot be accurately controlled, and therefore, when the pressing positions of sheets are shifted, sheets might not be stacked into the stacking orderly.

## Disclosure of the Invention

It is an object of this invention to provide a sheet stacker to enable to dissolve said various problems without using conventional overlap conveyor.

The sheet stacker of this invention for stacking sheets cut by a sheet cutter and transferred, into a stacking station, comprising;

a conveyor for transferring sheets cut by a sheet cutting machine, keeping a fixed sheet interval,

a clamping device for clamping a base position near the tail end of the sheet during transferring the sheet and reducing sheet travelling speed to an optimum speed needed for stacking the sheet into the stacking station orderly,

a servo motor for driving the clamping device, a servo amplifier for controlling the servo motor,

a sheet tail end position sensor for detecting the tail end of the sheet being transferred by the

conveyor,

a first speed sensor for detecting the speed of the conveyor,

a second speed sensor for detecting the rotating speed of the servo motor,

an origin sensor for detecting the origin of the clamping device,

a phase setter for setting the base position,

a first control circuit for performing phase speed equalizing control of the clamping device, based on outputs of the first sensor, the second sensor, the origin sensor, the sheet tail end position sensor and the phase setter, and a second control circuit for performing upper reference point determining control of the clamping device, based on outputs of the second speed sensor and the origin sensor.

The sheet stacker of this invention is featured by the fact that the clamping device has a rotating device having free rolls at its end and a slowdown roll, and that the free rolls contact with the slowdown roll and clamp the sheet once during each revolution of said rotating device.

Furthermore, the sheet stacker of this invention for stacking sheets cut by a sheet cutter and transferred into first and second stacking stations, comprising;

a conveyor for transferring sheets cut by a sheet cutter, keeping a fixed sheet interval,

a plurality of first pressing rolls installed on the tail end of the conveyor,

a diverter for moving the first pressing rolls up and down,

a first clamping device for clamping a base position near the back end of the sheet sent out from the first pressing rolls and reducing the sheet travelling speed to an optimum speed needed for stacking the sheet into the first stacking station orderly,

a first guide belt for guiding the sheet sent out from the first clamping device to the second stacking station,

a second conveyor for transferring sheets sent out from the first clamping device to the second clamping device described later,

a plurality of second pressing rolls installed on the tail end of the second conveyor,

a second clamping device for clamping base position near to the tail end of the sheet sent out from the second pressing rolls and reducing the sheet travelling speed to an optimum speed needed for stacking the sheet into the second stacking station orderly, and

a second guide belt to guide the sheet sent out from the second clamping device to the second stacking station,

whereby the sheet transfer direction is switched from the first stacking station to the second stack-

ing station and vice versa by switching the first pressing rolls up or down by the diverter.

#### Brief Description of Drawings

Fig.1 shows the construction of an embodiment of this invention.

Fig.2 is an perspective view of the rotating device.

Fig. 3 is a control diagram of the sheet stacker shown in Fig.1.

Fig.4 is a drawing showing position relationship of the rotating device.

Fig.5 shows speed patterns of the rotating device.

Fig.6 is a drawing describing movement of the rotating device.

Figs.7A and Fig.7B are drawings to describe conventional technologies.

Fig.8 is a drawing to describe another conventional technology.

#### Best Mode for Executing the Invention

Fig.1 is a drawing illustrating an embodiment of this invention where two sets of stacking zones are provided for changing skids and order.

This sheet stacker comprises a sheet cutting machine 10, a conveyor system 12 to transfer sheets from the sheet cutting machine, first and second clamping devices 14a and 14b to clamp sheet tail ends, and first and second stacking zones 16a and 16b to stack sheets.

The cutting machine 10 has a sheet cutter 18 which cuts corrugated cardboard, paper, plastic film, foil and the like to a specified length.

The conveyor system 12 is disposed downstream of the cutting machine 10 and has a conveyor 20 for transferring sheets, its length being set to longer than maximum cutting length of sheets. Pressing belts 22 consisting of several belts are installed on the conveyor 20, and pressing rolls 24a are disposed on the tail end of conveyor 20. These pressing rolls 24a are moved up and down by a diverter 26. Also, above the conveyor 20, a sheet tail end position sensor 34a is provided to detect the tail end of a sheet travelling on the conveyor 20. The speed of conveyor 20 is set at a few percent higher than web feeding speed to the cutting machine 10 so that the interval of cut sheets can be expanded.

The first clamping device 14a is a device to clamp tail ends of cut sheets. Under it, a slowdown roll 28a is installed to slow down sheet speed to an optimum speed and to send out sheets to the first stacking zone 16a. At an upper position of the first clamping device 14a, there is provided a rotating device 32a having free rolls 30a at its end to press

the cut sheet onto the slowdown roll via intervals of the pressing belts 22 and to equalize the speed of cut sheet to the speed of slowdown roll. For the slowdown roll 28a, high-friction rubber roll or the like is used depending on the kind of sheet material.

Fig.2 is a perspective view of the slowdown roll 28a and the rotating device 32a. The rotating device 32a comprises arms 302 fixed to rotating shafts 301, shafts 303 fixed to ends of these arms and free rolls 30a supported by these shafts 303 enabling to rotate freely. Though the figure shows only two free roll 30a in order to simplify the figure, an actual sheet staker has a plurality of the free rolls.

The rotating speed of the slowdown roll 29a is set based on the kind of material of sheet 11, the line speed and the cutting length of sheets. AC servo motor is controlled so that the arms 302 of the rotating device 32a can start tracking at the time when the sheet tail end position sensor 34a detects the tail end of a sheet, and that the free rolls 30a can press the sheet to the slowdown roll 28a via intervals of the pressing belts 22 and can clamp the sheet by equalizing the revolution speed of the free rolls 30a about the shafts 301 at a fixed position present from the base position near the tail end of sheet.

The first stacking zone has a first stacking station 38a installed on a first lifter 36a which moves up and down, and sheets are stacked to the stacking station.

At the first stacking zone 16a, a guide belt 40 to guide sheets to the first stacking station 38a and a sheet transfer belt 42 to send sheets to the second clamping device 14b are provided. On the tail end of sheet transfer belt 42, pressing rolls 24b are provided. Also, above the sheet transfer belt 42, a sheet tail end position sensor 34b is installed to detect the tail end of a cut sheet being transferred by the sheet transfer belt 42.

The pressing belts 22 of the conveyor system 12 are provided so that they can run through the first clamping device 14a, the first stacking zone 16a, the second clamping device 14b and the second stacking zone 16b via the pressing rolls 24a.

A sheet sent out from the conveyor 20 at a high speed travels along the lower surface of guide belt 40 running at the same speed as the pressing belt 22, and when the leading edge of sheet reaches at a certain position before a stopper 44a of the stacking station 38a, the sheet is clamped by the function of the clamping device 14a, is slowed down to an optimum speed, is stopped by the stopper 44a and is stacked into the first stacking station 38a. In the first stacking station, the sheet is aligned by side jogging and front jogging and is

stacked orderly. Moving down of the lifter is controlled so that the uppermost surface of the stacking pile is always kept at a fixed level by a sensor.

In the above-mentioned stacking operation where sheets are stacked into the first stacking station 38a of the first stacking zone 16a, the sheets sent out from the conveyor system 12 at a high speed are sent to the stacking station 38a through the first clamping device 14a and along the lower surface of the guide belt 40.

In case that skid change or order change is to be performed without changing operating speed, the diverter 26 is actuated by a signal of skid change and moves the pressing rolls 24 up (as shown in the figure), the sheets sent out from the conveyor system 12 at a high speed travel on the upper surface of the sheet transfer belt 42 running at the same speed as the conveyor 20, and are sent to the second clamping device 14b, being pressed by the pressing belt 22.

The second clamping device 14b is a device to clamp the tail end of a cut sheet, has at a lower position of the device a slowdown roll 28b to slow down the sheet to an optimum speed and to send out the sheet to the second stacking zone 16b, and has at an upper position of the device a rotating device 32b having free rollers 30b to press the sheet tail end to the slowdown roll via the intervals of the pressing belts 22 and to equalize the speed of sheets to the speed of slowdown roll. Because the functions of second clamping device are same as those of first clamping device, the description of the second clamping device is omitted here.

The second stacking zone 16b has a second stacking station 38b placed on a second lifter 36b movable up and down and a stopper 44b.

A sheet sent out from the sheet transfer belt 42 at a high speed travels along the lower surface of the pressing belt 22 in the stacking zone 16b, and when the leading edge of sheet reaches at a certain position before the stopper 44b of the stacking station 38b, the sheet is clamped by the actions of the second clamping device 14b, is slowed down to an optimum speed, is stopped by the stopper, and is stacked into the second stacking station 38b. In the second stacking station 38b, the sheet is aligned by side jogging and is stacked orderly. Moving down of the lifter is controlled so that the uppermost surface of the stacking pile is kept at a certain level by sensor.

Now, the control system of the sheet staker of this embodiment is explained with reference to Fig.3. Fig.3 shows a control system for the first conveyor system 12, the first clamping device 14a and the first stacking zone shown in Fig.1. Because the control system for the second clamping device 14b and the second stacking zone 16b is same as that for the first clamping device 14a and the first

stacking zone 16a, only the control system for the first clamping device 14a and the first stacking zone 16a is described here as representative.

The control is divided into phase speed equalizing control and upper reference point determining control.

The phase speed equalizing control is to control to equalize the revolution speed of free rolls 30a about the shafts 301 to the sheet transfer speed by clamping a sheet at a specific position from the sheet tail end by the free rolls, when the rotating device 32a clamps the sheet 11.

The phase control is performed as follows. Phase setter 58 is preset at the value of  $(L-X)$  which is obtained by subtracting the distance  $(X)$  between the tail end position of the sheet 11 and the clamping position from the distance  $(L)$  between the lower reference point of the rotating device 32a and the sheet tail end position sensor 34a. This is the phase setting that is to set the phase setter 58 to the value of  $(L-X)-B_0$  after converting to pulse, based on the slowdown position signal A (the signal showing slowdown starting position located at an angle of  $90^\circ$  from the lower reference point of the rotating device) obtained from the origin detected by the origin sensor 60 installed near the rotating device 32a. The value of  $B_0$  is a circumferential length of the circle drawn by the farthest point from the revolution center when the free rolls 30a of the rotating device 32a revolves about the shafts 301. The sheet transfer length is obtained by opening the gate 66 by the signal C generated when the sheet tail end position sensor 34a detects the tail end of a sheet, by inputting to the adder 76 the pulse from the pulse generator (PG) 50 as a subtracting input, and by closing the gate 66 by the slowdown position signal A. The adder 76 subtracts the pulse AA of sheet transfer length passed through the gate 66. When the free rolls 30a of the rotating device 32a reach at the target clamping position which is the position to start acceleration, the rotating device starts acceleration, and then, before the free rolls 30a contact the sheet 11, speed equalization is performed by the speed equalizing functions described later and simultaneously, phase adjustment is performed by the following equation. The value B of position deviation counter 64 is expressed by the following equation.

$$R = ((L-X)-B_0)-AA + BB$$

where BB is the count value of pulse of the pulse generator (PG) 68 installed at the AC servo motor to drive the clamping device (count-base slowdown start point).

This calculation is performed by the adder 76, and the position deviation counter 64 keeps the

value R. Because the phase control aims to make the deviation zero, the value of R in the above equation finally becomes zero. Because the value of BB finally corresponds to one revolution of the rotating device, the value of BB becomes equal to the value of  $B_0$ . From this relation and the relation of  $R=0$ , therefore, the relation of  $AA=(L-X)$  is obtained, and it becomes possible to set the value of AA, i.e. the clamping position to a position X from the sheet tail end.

The speed equalizing control is performed as follows. The deviation R is converted to an analog signal  $V_C$ . Furthermore, the frequency of pulse generated by the pulse generator 50 installed at the conveyor system 20 is converted to voltage signal by frequency/voltage (F/V) converter 52, and thus, the line speed i.e. the travelling speed of sheet 11 is detected and is sent to the adder 80 as an adding input. The output of adder 80 ( $V_A-V_C$ ) is sent to the servo amplifier 57 of the AC servo motor 56 for driving the rotating device 32a as a command for phase equalization through speed command selecting circuit 54 described later. When  $R=0$ ,  $V_C$  becomes zero and the speed command ( $V_A-V_C$ ) becomes equal to  $V_A$ , and thus, the revolution speed of the free rolls about the shafts 301 is equalized to the sheet travelling speed.

The upper reference point determining control is a function required to have the free rolls 30a of the rotating device 32a wait for arrival of a sheet as shown in Fig.4 when sheets are not supplied continuously. By the slowdown position signal A from the origin sensor 60, the upper reference point deviation counter 70 is to set a circumferential length up to the upper reference point, and after subtracting the pulse from the pulse generator 68, produces a speed command  $V_B$  through a D/A converter 72 and a speed command clamp circuit 74. The position at zero count is determined, and the rotating device 32a is stopped at the upper reference point.

The above-mentioned speed command ( $V_A-V_C$ ) for the phase speed equalizing control and the speed command  $V_B$  for the upper reference point determining control are sent to the speed command selecting circuit (higher voltage selecting circuit) 54, which selects a higher voltage of command and outputs a speed command B to the servo amplifier 57.

The speed pattern of the rotating device is either pattern 1, 2 or 3 shown in Fig.5 depending on the sheet interval.

The pattern 1 is for a longer sheet interval. when the sheet tail end position sensor 34a detects a sheet tail end at time  $t_1$ , the rotating speed of the rotating device is accelerated by the speed command ( $V_A-V_C$ ) and reaches at the line speed at time  $t_2$ , and the rotating device keeps this speed until

time  $t_3$ . After the time  $t_3$ , the speed command is switched to the speed command  $V_B$  and slows down the rotating device, which arrives at the upper reference point at time  $t_4$  and stops at the upper reference point until time  $t_5$  when the tail end of the next sheet is detected.

The pattern 2 shows the case that the next sheet arrives before the rotating device stops at the upper reference point. In this case, when the tail end of a sheet is detected, the rotating device is controlled by the speed command ( $V_B-V_C$ ) until time  $t_6$ , and is controlled by the speed command  $V_B$  from time  $t_6$  to time  $t_7$ .

The pattern 3 shows the case that sheet interval is shorter than the set length of (L-X). In this case, the rotating device is controlled by the speed command ( $V_A-V_C$ ), starts to be accelerated from the line speed at time  $t_8$ , starts to be slowed down at time  $t_9$ , and is equalized to the line speed at time  $t_{10}$ .

Now, the behavior of the pattern 1 explained, with reference to Fig.6, which shows the revolution of the free rolls 30a of the rotating device 32a.

A sheet 11 cut by a sheet cutter is transferred by the conveyor 20 towards the first stacking zone 16a. When the sheet tail end position sensor detects the tail end of sheet 11, the gate 66 is opened, the pulse AA generated by the pulse generator 50 is sent to the adder 76, the free rolls 30a, which were stopping at the upper reference point as shown in the upper figure of Fig.6, start to be accelerated by the speed command ( $V_A-V_C$ ) as shown in the middle figure of Fig.6, and the speed equalization is performed. When the deviation R of the deviation counter 64 becomes zero, the free rolls 30a clamp the sheet at the clamping position located at a position X from the sheet tail end, slow down the sheet and send it to the stacking station 38a.

When the free rolls 30a arrive at the slowdown point, the speed command is switched to the speed command  $V_B$ , and the free rolls 30a start to be slowed down and stop at the upper reference point.

In the above, the case of the pattern 1 in Fig.5 was described. The behaviors of the remaining patterns 2 and 3 could be understood easily by persons skilled in the art.

#### INDUSTRIAL APPLICABILITY

Because a sheet stacker of this invention can slow down sheet transfer speed to an optimum speed regardless of cutting length of sheet cut off by a cutter, by clamping a base position near the tail end of a travelling cut sheet and can stack the sheet directly without overlapping sheets, production or grazes caused by friction of sheet surfaces

due to overlapping can be eliminated, and also length of sheet transfer conveyor downstream of the cutter can be shortened.

Furthermore, a sheet stacker of this invention has an effect to enable to send sheets to be stacking station normally, even if various kinds of sheet materials are handled.

#### Claims

1. A sheet stacker for stacking sheets cut by a sheet cutter and transferred, into a stacking station, comprising;

- a conveyor for transferring sheets cut off by a sheet cutter, keeping a fixed sheet interval,

- a clamping device for clamping a base position near the tail end of the sheet during transferring the sheet and reducing sheet travelling speed to an optimum speed needed for stacking the sheet into the stacking station orderly,

- a servo motor for driving the clamping device,

- a servo amplifier for controlling the servo motor,

- a sheet tail end position sensor for detecting the tail end of the sheet being transferred by the conveyor,

- a first speed sensor for detecting the speed of the conveyor,

- a second speed sensor for detecting the rotating speed of the servo motor,

- an origin sensor for detecting the origin of the clamping device,

- a phase setter for setting the base position,

- a first control circuit for performing phase speed equalizing control of the clamping device, based on outputs of the first sensor, the second sensor, the origin sensor, the sheet tail end position sensor and the phase setter, and

- a second control circuit for performing upper reference point determining control of the clamping device, based on outputs of the second speed sensor and the origin sensor.

2. A sheet stacker as set forth in claim 1 wherein the rotating device has free rolls at its end and a slowdown roll, and the free rolls contact with the slowdown rolls once during each revolution of the rotating device and clamp the sheet.

3. A sheet stacker for stacking sheets cut by a sheet cutter and transferred into first and second stacking stations, comprising;
  - a conveyor for transferring sheets cut by a

sheet cutter, keeping a fixed sheet interval,

a plurality of first pressing rolls installed on the tail end of the conveyor,

a diverter for moving the first pressing rolls up and down,

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a first clamping device for clamping a base position near the back end of the sheet sent out from the first pressing rolls and reducing the sheet travelling speed to an optimum speed needed for stacking the sheet into the first stacking station orderly,

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a first guide belt for guiding the sheet sent out from the first clamping device to the second stacking station,

a second conveyor for transferring sheets sent out from the first clamping device to the second clamping device described later,

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a plurality of second pressing rolls installed on the tail end of the second conveyor,

a second clamping device for clamping base position near to the tail end of the sheet sent out from the second pressing rolls and reducing the sheet travelling speed to an optimum speed needed for stacking the sheet into the second stacking station orderly, and

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a second guide belt to guide the sheet sent out from the second clamping device to the second stacking station,

whereby the sheet transfer direction is switched from the first stacking station to the second stacking station and vice versa by switching the first pressing rolls up or down by the diverter.

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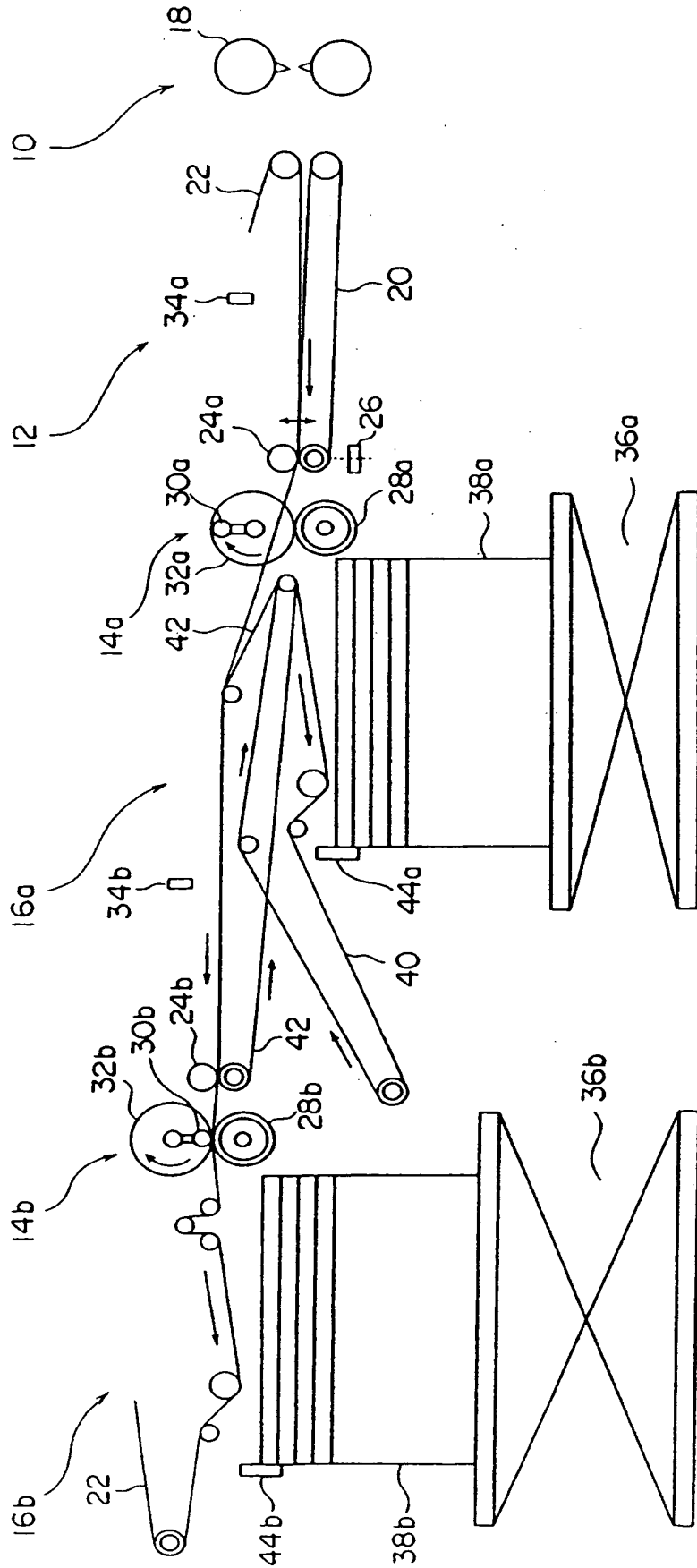


FIG. 1

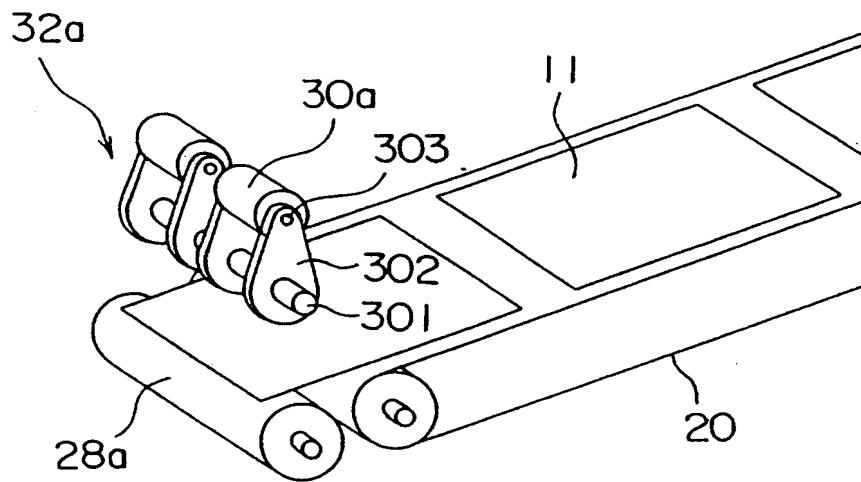


FIG. 2

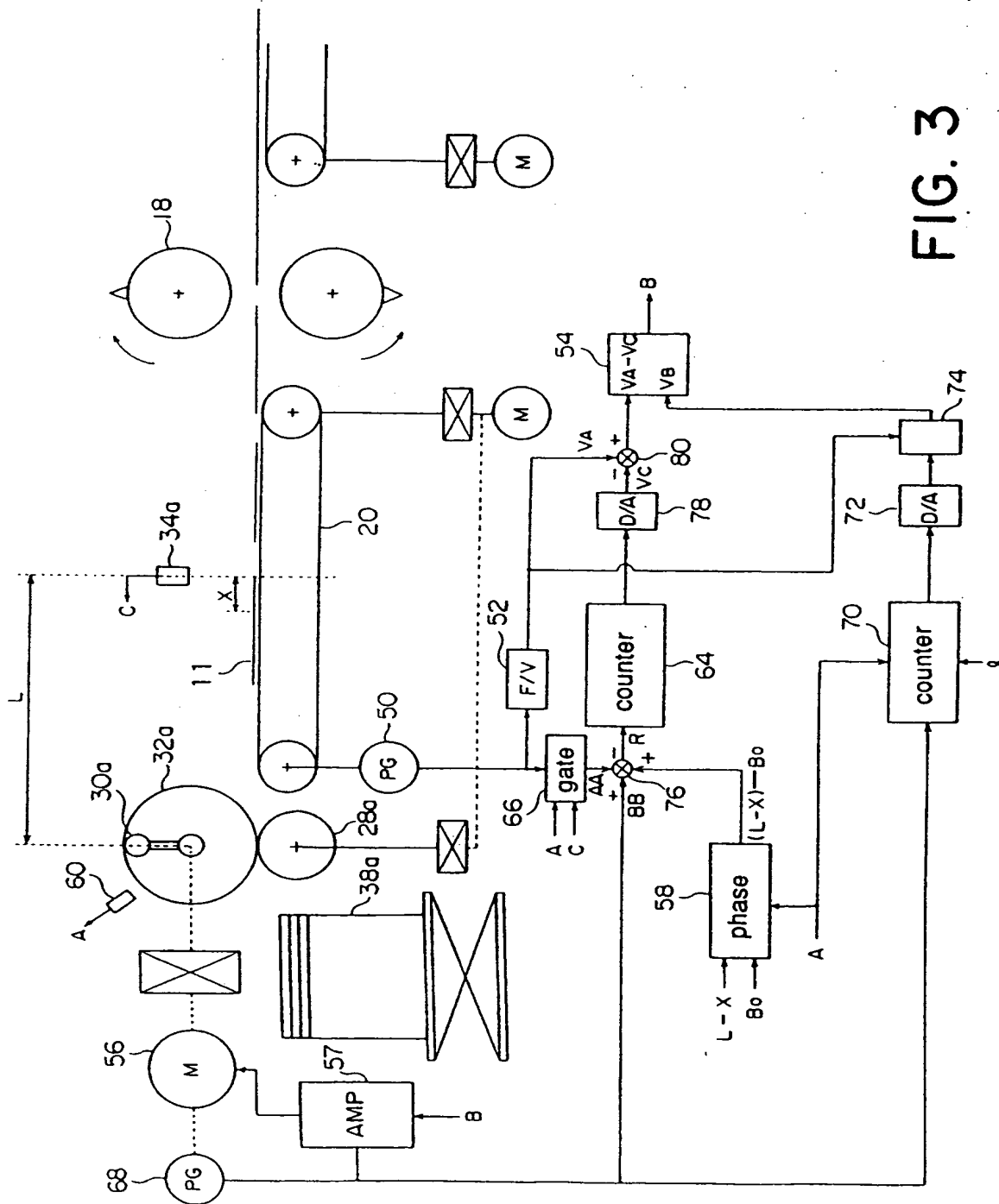


FIG. 3

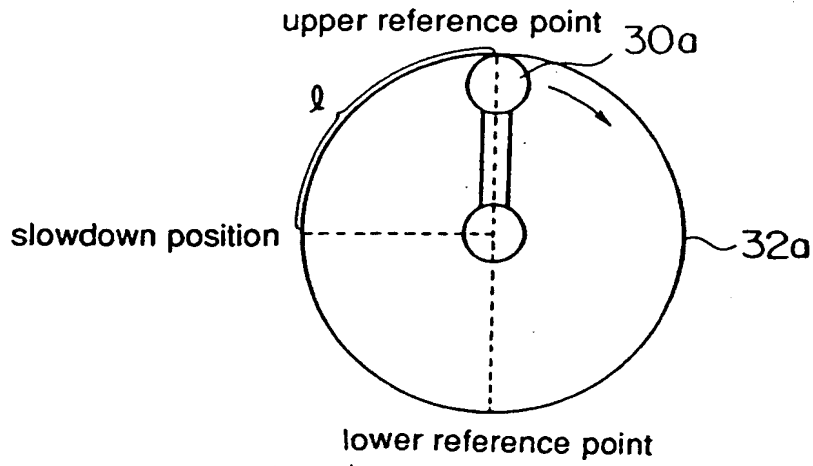


FIG. 4

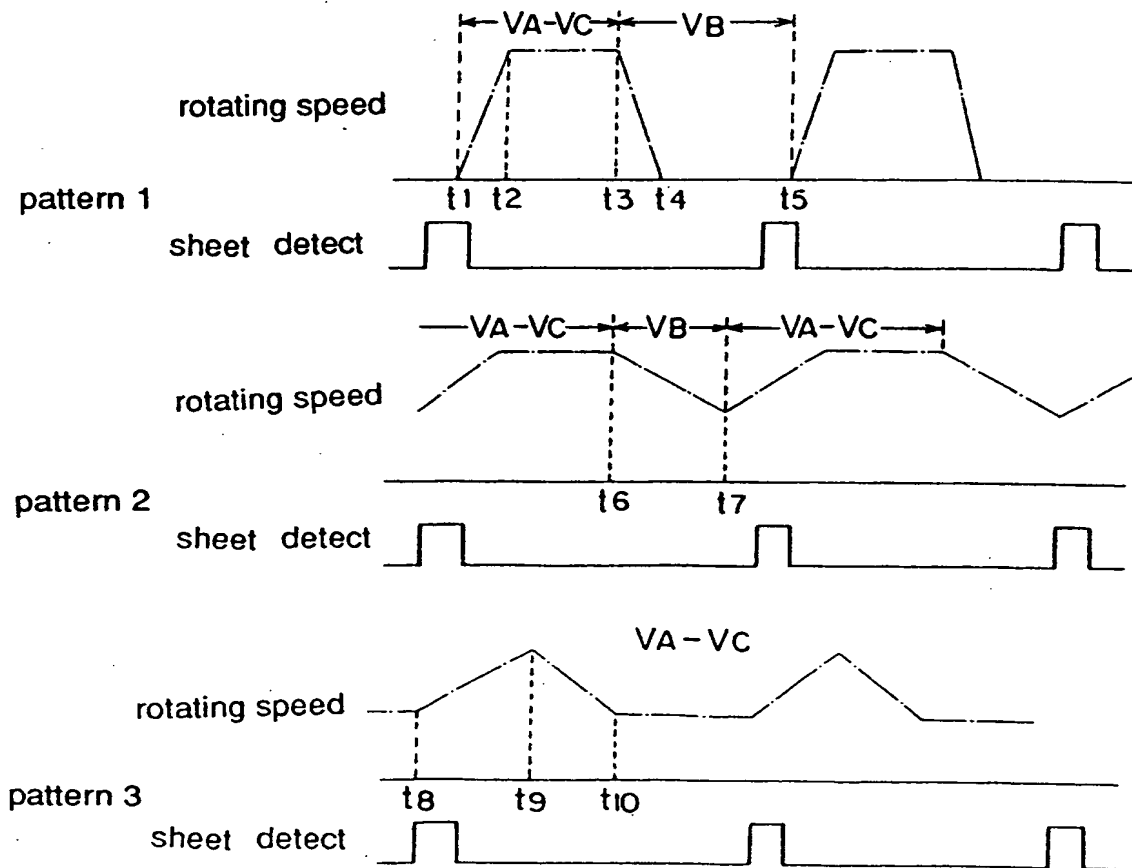


FIG. 5

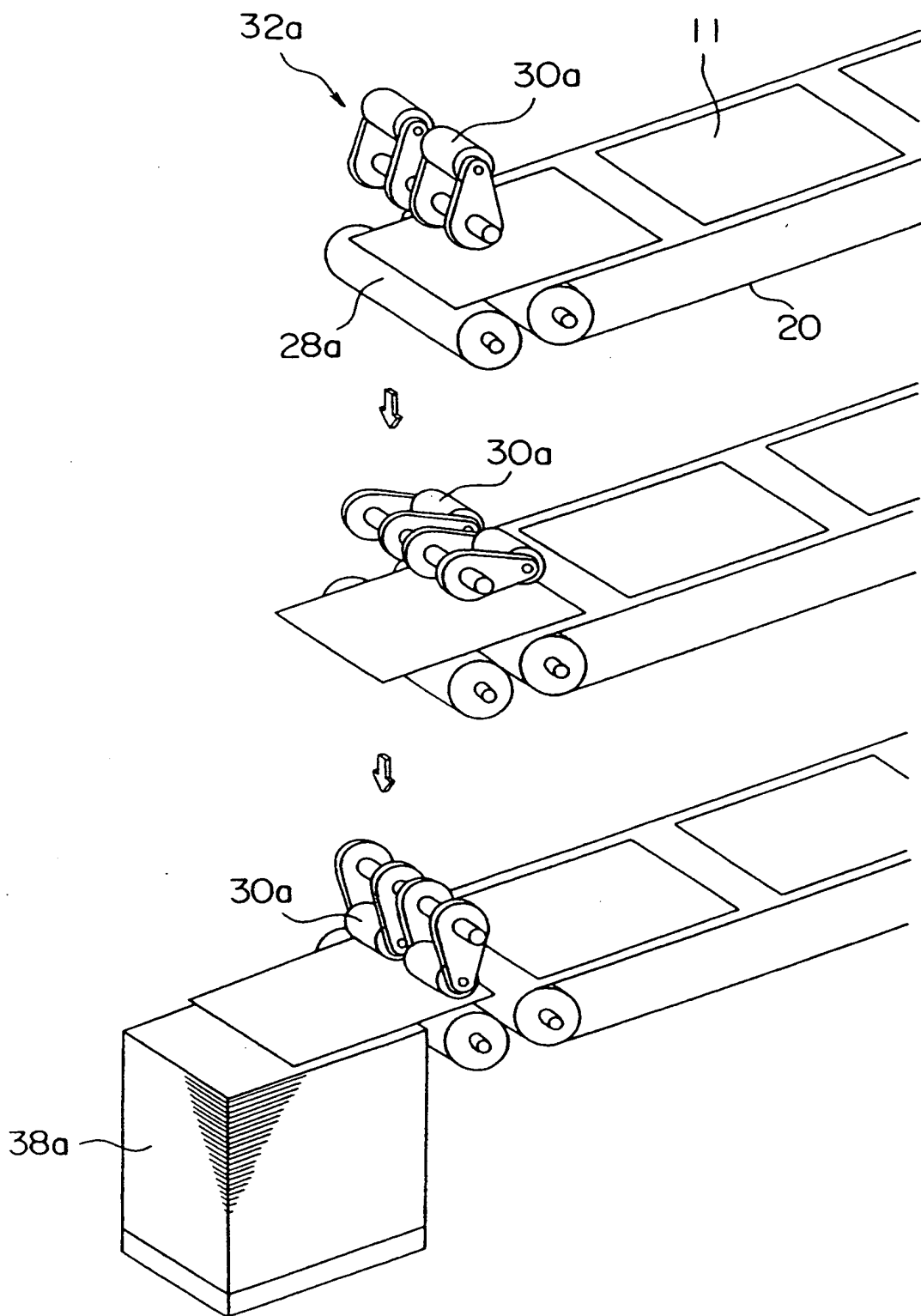


FIG. 6

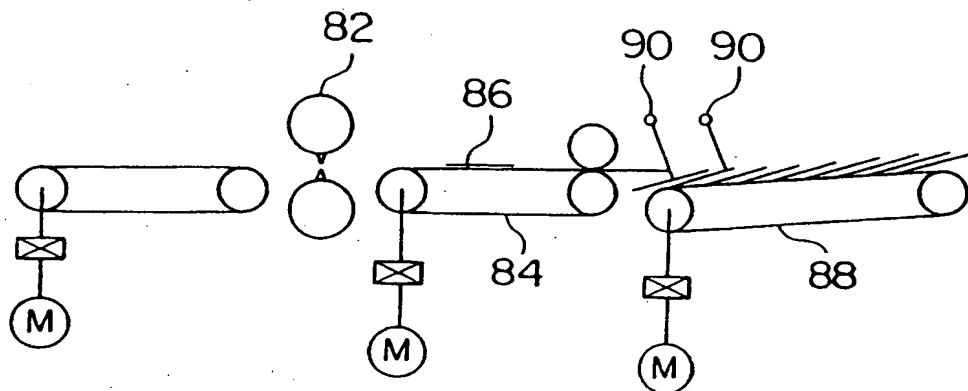


FIG. 7A

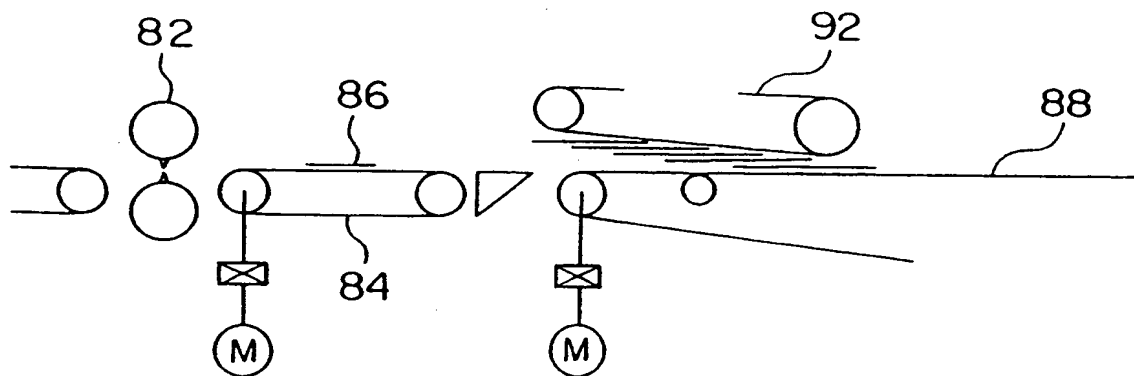


FIG. 7B

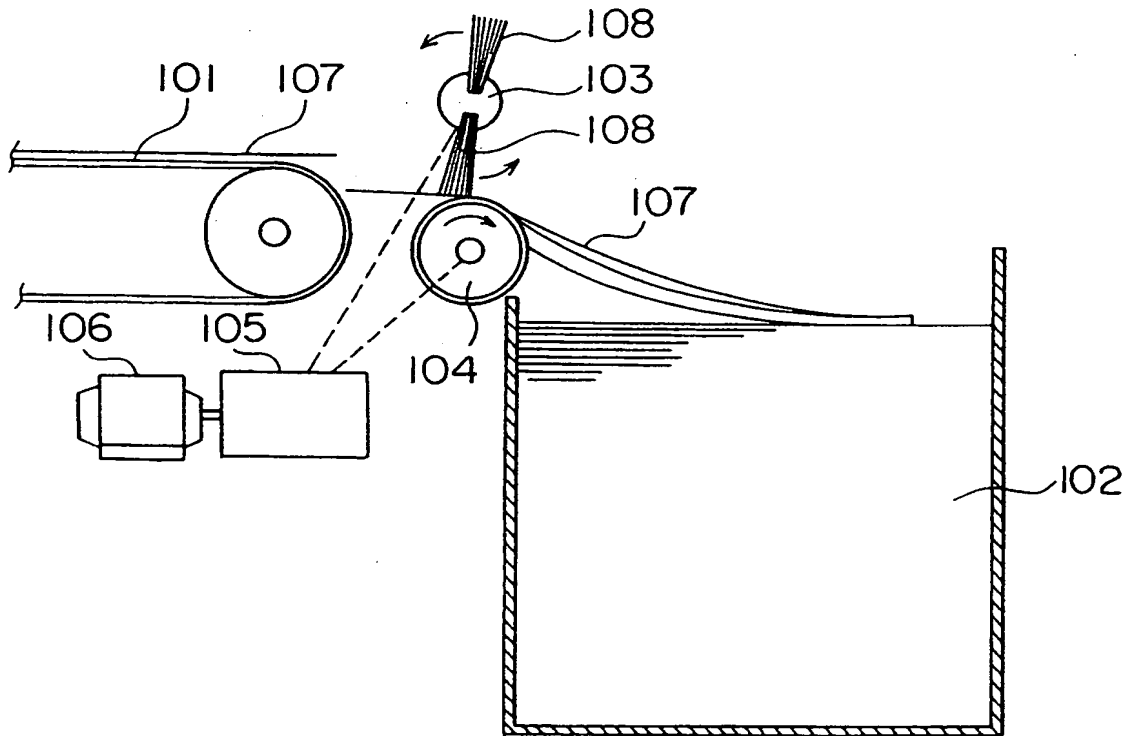


FIG. 8

# INTERNATIONAL SEARCH REPORT

International Application No. PCT/JP91/01399

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (If several classification symbols apply, indicate all) *		
According to International Patent Classification (IPC) or to both National Classification and IPC		
Int. Cl <sup>5</sup> B65H29/68, 29/60		
<b>II. FIELDS SEARCHED</b>		
Minimum Documentation Searched *		
Classification System	Classification Symbols	
IPC	B65H29/68, 29/60	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched *		
Jitsuyo Shinan Koho		1928 - 1991
Kokai Jitsuyo Shinan Koho		1971 - 1991
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT *</b>		
Category *	Citation of Document, ** with indication, where appropriate, of the relevant passages **	Relevant to Claim No. **
Y	JP, B2, 53-11100 (Hitachi, Ltd.), April 19, 1978 (19. 04. 78), Line 35, column 2 to line 13, column 6 (Family: none)	1, 3
Y	JP, B2, 51-38985 (Hitachi, Ltd.), October 25, 1976 (25. 10. 76), Lines 19 to 36, column 5 (Family: none)	1, 3
Y	JP, A, 61-136858 (Sumitomo Heavy Industries, Ltd.), June 24, 1986 (24. 06. 86), Line 14, column 1, page 2 to line 4, column 2, page 3 (Family: none)	1, 3
A	JP, A, 63-196455 (Hitachi Seiko, Ltd.), August 15, 1988 (15. 08. 88), Line 17, column 4, page 2 to line 7, column 1, page 3 (Family: none)	1, 3
<p>* Special categories of cited documents: **</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&amp;" document member of the same patent family</p>		
<b>IV. CERTIFICATION</b>		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
November 26, 1991 (26. 11. 91)	December 9, 1991 (09. 12. 91)	
International Searching Authority	Signature of Authorized Officer	
Japanese Patent Office		

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## FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

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|---|---|------|
| A | JP, B2, 61-23147 (Beloit Corp.),<br>June 4, 1986 (04. 06. 86),<br>Line 33, column 6 to line 19, column 7<br>& EP, A, 66529 & ES, A, 512266<br>& ES, A, 8304876 & US, A, 4436302<br>& CA, A, 1175452 | 1, 3 |
| A | JP, Y1, 45-25604 (Mitsubishi Heavy<br>Industries, Ltd.),<br>October 6, 1970 (06. 10. 70),<br>Line 18, column 3 to line 33, column 4<br>(Family: none)   | 3    |

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers . . . because they relate to subject matter not required to be searched by this Authority, namely:
  
2. ☐ Claim numbers . . . because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
  
3. ☐ Claim numbers . . . because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application
2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:
3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:
4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee

## Remark on Protest

- ☐ The additional search fees were accompanied by applicant's protest  
☐ No protest accompanied the payment of additional search fees

## FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

A JP, B1, 42-13339 (Minami Senju Seisakusho, K.K.),  
 July 29, 1967 (29. 07. 67),  
 Line 11, left column to line 10, right  
 column, page 2 (Family: none)

3

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers because they relate to subject matter not required to be searched by this Authority, namely:
  
2. ☐ Claim numbers because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
  
3. ☐ Claim numbers because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application
2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:
3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:
4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

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- ☐ The additional search fees were accompanied by applicant's protest  
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